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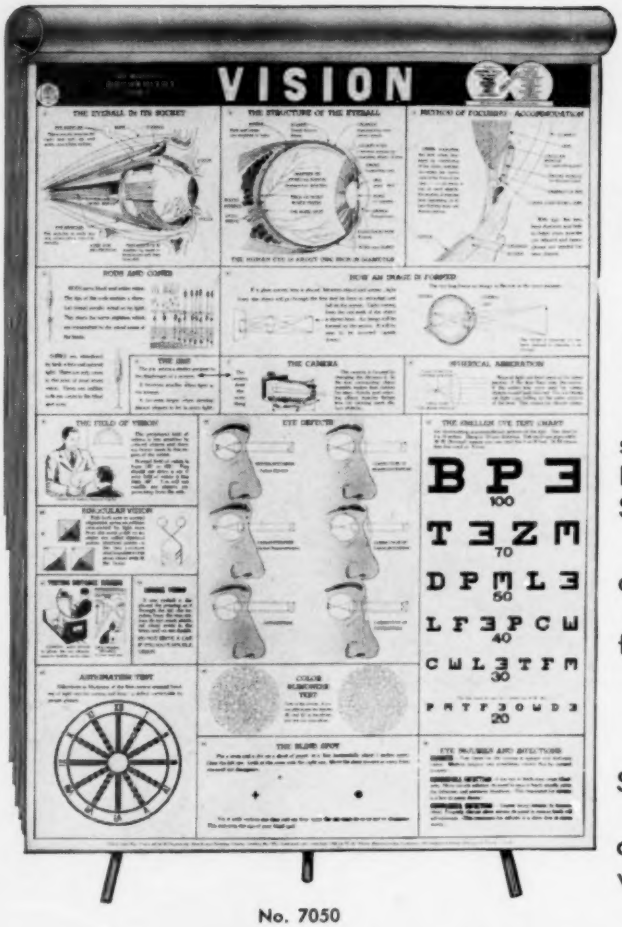

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The American Biology Teacher

Vol. 14 JANUARY, 1952 No. 1

Aids in Demonstrating Evolution of Oxygen during Photosynthesis

BARRY JAY NEWMAN and EDWIN THOMA *

Pennsylvania State Teachers College, West Chester, Pennsylvania

One of the ever prevalent problems facing the biology teacher is that of demonstrating to a class that oxygen is a by-product of photosynthesis. The procedure often undertaken is similar to that suggested by L. H. Tiffany in his laboratory manual, *The Study of Plants*. He suggests the following: a funnel be inverted over a fresh water plant such as eel grass, water weed (*Elodea, etc.*) contained within a battery jar filled with water. The funnel should be suspended several inches from the bottom of the jar so that the natural circulation of the water is unhindered. A water-filled test tube should be inverted over the narrow end of the funnel in such a manner that the open end of the test tube is below the water level in the jar. Thus any gas bubbles produced by the green plants will rise through the funnel and displace the water in the test tube.

The authors conducted this experiment using *Elodea* and found that little or no gas collected. Further experimentation showed that the original conditions of the experiment were inadequate to secure the desired results. In an effort to determine the factors contributing to the failure of the demonstration the authors found the following:

1. The water in the battery jar had become too acid for the plant. This decrease in the pH (potential of Hydrogen) value of the water was instrumental in arresting the desired reaction.
2. A light-meter reading of 35–50 foot-candles (on a cloudy day) indicated that the plant might not be getting sufficient light.

We again set up the experiment as stated above, but realizing the incompleteness of the instructions we added calcium in the form of slaked lime to neutralize the acidic condition. A 75-watt incandescent lamp was placed one foot from the jar. This lamp was lighted 24 hours a day. The results were again disappointing; the plant died in a rela-

* Mr. Newman and Mr. Thoma are botany students of Robert B. Gordon, who is the head of the Department of Science at West Chester.

tively short time (10 days). In an effort to determine the factors contributing to the death of the plant the water was tested again. The results of this second test showed that the calcium had not only been effective on neutralizing the acid, but had also raised the pH value of the water to such a point that the plant could not survive. It was obvious that slaked lime had been used in too abundant a quantity.

Once again we set up our apparatus according to the original instructions, and a 75-watt incandescent lamp was again lighted one foot from the battery jar. We decided to try stimulating photosynthesis by adding a commercial preparation called " Plant-Chem " Salts.[1] This preparation contains the following ingredients:

Nitrogen	4.0 %
Phosphoric acid	7.0 %
Potash	10.0 %
Plant hormone from phenylacetic acid	0.002%
Boron derived from boric acid	0.017%
Calcium derived from calcium sulphate	2.000%
Chlorine from vanadium chloride	0.001%
Chromium from chromium nitrate	0.001%
Cobalt from cobalt nitrate	0.001%
Copper from copper sulphate	0.002%
Iron from iron sulphate	0.010%
Magnesium from magnesium sulphate	0.025%
Manganese from manganese sulphate	0.024%
Molybdenum from molybdic acid	0.001%
Nickel from nickel sulphate	0.001%
Sulphur combined with sulphates of ammonia, calcium and magnesium	3.000%
Tin from tin chloride	0.002%
Titanium from titanium dioxide	0.001%
Tungsten from potassium tungstate	0.001%
Vanadium from vanadium chloride	0.001%
Zinc from zinc sulphate	0.001%

After having added the salts we tested the water and found the pH to be seven (7) or neutral. To this mixture one drop of yeast extract (vitamin B complex) was added to help increase the rate of protoplasmic streaming with the idea that it might increase the amount of photosynthesis.[2]

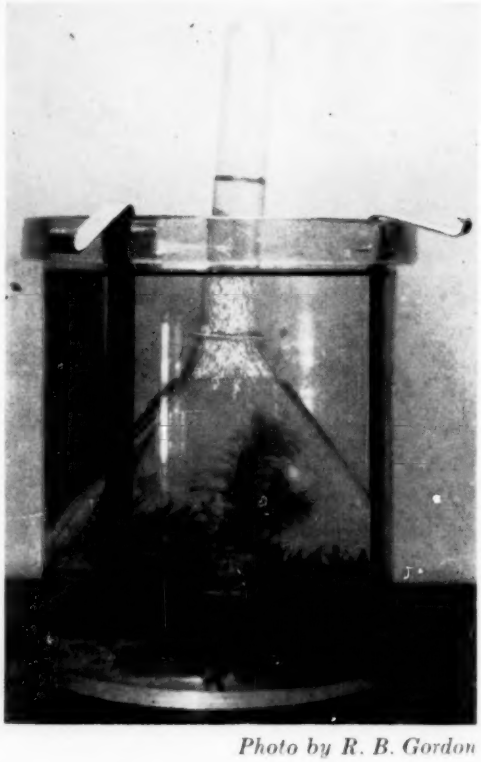

Photo by R. B. Gordon

This experiment resulted in a successful demonstration in a comparatively short space of time—two days. During this two-day period gas bubbles could readily be observed rising from the green plant through the funnel and displacing the water in the test tube. Our next step was to determine whether any oxygen was present in the test tube. This was accomplished by thrusting a glowing splint into the tube. The test was definitely positive for the presence of oxygen.

Therefore, in summary it may be concluded that to demonstrate that one of the gaseous by-products during photosynthesis is oxygen the following conditions are necessary:

[1] "Plant-Chem" Salts, University Hydroponic Service, 1355 Market Street, San Francisco, Calif.

[2] Gordon, R. B., Vitamin B Activation of Protoplasmic Streaming, *The Educational Focus*, Vol. 17, No. 3, p. 18. 1948.

1. The pH value of the water should be as near to seven as possible.
2. 75 to 100 foot-candles of illumination is adequate.
3. Mineral salts and vitamins should be added to stimulate various processes of the plant.

In conducting this experiment the authors used the following equipment:

1. One test tube 6 inches long and 25 mm. in diameter.
2. One funnel 5¾ inches in diameter at the end.
3. One battery jar 6⅛ inches inside diameter, 8¼ inches in height, volumetric capacity, 3780 ml., water in jar during experiment, 3300 ml.
4. *Elodea canadensis* var. *gigantea* Hort., "Giant Water Weed," 36 inches in length of stem segments.
5. Aluminum strips were used as supports for the funnel—6½ inches long. (However, we would suggest the use of glass or plastic strips because the "Plant-Chem" Salts reacted with the metal strips.)
6. 7 drops of Plebex (B-complex) vitamin solution, 1 capsule to one pint of water.
7. "Plant-Chem" Salts, as directed on the package.

Although the authors used these quantities in conducting this experiment, the teacher can conduct this demonstration using equipment of different specifications provided that the "Plant-Chem" Salts and vitamins are added in proportion to the amount of water in the container.

Teaching Unit for the Study of Trees*

THOMAS R. PORTER
City College of San Francisco, San Francisco 12, California

THE STUDY OF TREES

(GRADES 4 TO 6)

I. Objectives of This Unit

A. *General:*

1. To teach children to locate and use reference material.
   a) Locate material by:
      1) Use of school library.
      2) Reference shelves.
   b) Write to proper authorities, offices, and companies for information.
      1) United States Department of Agriculture.
      2) State Department of Forestry.
      3) Paper companies, lumber companies, etc.
   c) How to use reference material:
      1) Use of index and/or table of contents in books.
      2) Use of table of contents in magazines such as "American Forests," etc.
2. To teach children how to answer their own questions by use of reference material and experimental procedure.
3. To encourage extra reading.
4. To give a deeper appreciation of nature by considering:
   a) Importance of plants to our lives.
   b) Relationships between plants and animals.
   c) Activities of plants (physiology).
5. To adjust children to group work and cooperation as members of society.
6. To teach children how to attack a problem by planning their work in a systematic way .
7. To show relationship between science and other subjects.

B. *Specific:*

1. To emphasize man's dependence upon trees and other plants.

* Prepared under the direction of Miss Lydia E. Elzey, Assistant Professor of Elementary Education, Pennsylvania State College, State College, Pa.

2. To consider the contributions trees make to man's way of life.
3. To study distribution of different kinds of trees in the United States. (Introduction to ecological approach.)
4. To develop skill in:
   a) *Reading*—by use of reference material.
   b) *Writing*—by making written inquiries to different agencies for information or request for a speaker.
   c) *Language Arts:*
      1) Composing letters for information.
      2) Giving oral class reports.
   d) *Art*—by making:
      1) Posters for bulletin boards.
      2) Murals for class room use.
      3) Drawing leaves, trees, etc.
   e) *Observation*—by noting differences between trees'
      1) Leaves.
      2) Bark.
      3) Growth patterns.
      4) Location of growth or habitat.
      5) Fruits.
   f) *Music Appreciation*—There is much music which could be used, e.g.:
      1) Brahms—*Dim-lit Woods.*
      2) Chausson—*In the Enchanted Forest.*
      3) Kilmer, Rasbach—*Trees.*

II. Introduction to Unit

A. *How to create interest in this subject, or motivation:* (Different possibilities.)
   1. Ask class to collect leaves to draw and/or paint for art lesson.
      a) Encourage children to:
         1) Note differences in leaves they have collected.
         2) Tell about the trees from which they collected their leaves.
         3) Tell about trees they have seen on trips to other localities.
         4) Recall differences in trees they have seen on their way to school.
         5) Consider all the things man obtains from trees.
         6) Consider importance of leaves to:
            a. The tree itself.
            b. To man and other animals (food, protection, etc.).
         7) Press leaves and start a leaf collection.
      b) Encourage (by class discussion) arguments and questions to arouse the class so it will decide to investigate further to settle the arguments and answer the questions.
   2. The teacher might bring to class a few branches of different trees collected on way to school and then:
      a) See how many the children can identify.
      b) Point out differences in leaves, bark, etc.
      c) See how many children can tell the age of the branches.
   3. The teacher might merely ask the children to make a count of the *different* kinds of trees seen on the way to school. (This should be good to start an argument which would lead to a study of trees.)
   4. Such a unit might be a natural outgrowth of what the class did and saw during summer vacation.

III. Outline of Likely Subject Matter

A. *The leaves of different kinds of trees are different:*
   1. On basis of leaf shape there are two classes of trees:
      a) *Trees with broad, flat leaves.*
         1) Some of these trees loose all their leaves every fall.
         2) The other trees of this group retain their leaves for years or longer.
      b) *Trees with small needle-like (or awl-shaped) leaves.*
         1) Most of these trees retain their leaves for at least two years.
         2) These trees never loose all their leaves at once.
         3) Most of these trees produce cones.

B. *Functions of leaves:*
   1. Water loss in vapor form—*transpiration.*
      a) Values:
         1) Adds moisture to air.
         2) Acts as a means of cooling leaves and air around trees. (This is one reason why forests are cooler.)
   2. Manufacture food for the plant—*photosynthesis.*
      a) Raw materials:
         1) Water (from soil).

2) Carbon dioxide (from air, soil, and respiration).
b) Requires:
1) Presence of light.
2) Presence of chlorophyll.
3) Favorable temperature.
c) Direct end products:
1) Oxygen.
2) Glucose.
d) Importance of process:
1) Life itself is dependent on photosynthesis.
a. Source of food for plant.
b. Produces food for man and other animals.
c. All plant products can be traced back to this process as initial source.

3. At this point show:
Movies:
"Leaves"; "Gift of Green."
Filmstrips:
"Food from the Sun"; "Forest Trees"; "Forest Conservation."
(See part V.)

C. *Growth of trees:*
1. Trees live for many years.
a) Some trees are the oldest known living organisms on earth. (Sequoias of California.)
b) Growth rings in the wood tell us many things of the past.
1) Weather conditions, rainfall, etc.
2) When forest fires occurred.
3) Whether the tree was crowded close to its neighbors.
2. Trees add one layer of wood each year to their stems.
a) This growth ring is called an "annual ring."
b) The annual ring is added to the tree's circumference by a special layer called the "cambium." (Grafting could be introduced here if called for.)
3. Trees grow in height from the tips of their twigs.
4. Different kinds of trees grow in different parts of the country.
a) Broad-leafed, hard wood forests in eastern United States.
b) Coniferous, soft wood forests of western and northwestern United States.
c) Non-deciduous, broad-leafed trees in semi-tropical and tropical localities.
d) Deciduous and coniferous trees in colder climates.

D. *Trees produce many useful things:*
1. Wood—lumber for buildings, furniture, etc.
2. Food—spices and condiments.
—walnuts and other fruits such as apples, peaches, coconuts, etc.
—chocolate and sugar.
3. Medicine—quinine, etc.
4. Turpentine.
5. Paper. (Show movie: "Trees to Tribunes"—see part V.)

E. *Other benefits from trees:*
1. Root systems keep soil from being washed from hills and mountains. Soil erosion prevention—hence *conservation.*
2. Beautify the landscape.
3. Ground cover of trees has an effect on temperature and rainfall of a given region.
4. Serve as windbreaks.
5. Provide homes and protection for many lower animals.

IV. Activities

A. *For teacher:*
1. Organize material for actual teaching by directing class discussion to determine:
a) What children already know about trees.
b) What more the children want to know.
1) Organize these problems into sensible outline.
2) Add points to the outline to give continuity and completeness to the project.
2. Organize activities for children individually and class which will solve problems brought up.
3. Coordinate and integrate activities with:
a) Subject matter to be covered.
b) With other subjects, i.e., social studies, art, etc.
4. Determine equipment and materials which will be necessary.
5. Determine methods (to suggest to class) to obtain necessary materials and equipment.
6. Collect needed materials for unit which couldn't locate.
7. Evaluate unit after it has been completed. (See below—Part VI.)

B. *For individual pupils:* (Each child would choose several activities from this list.)
1. Collect different kinds of leaves of trees.

2. Bring any books or specimens from home which are pertinent.
3. Collect as many different kinds of cones as possible.
4. Try to locate and bring to class cross section of tree trunk or branch to show annual growth rings.
5. Count growth rings to tell age of tree or branch.
6. Collect samples of wood for a class collection.
7. Dissect a bud and note tiny, immature leaves and stem.

C. *Class:*

1. Organize into study groups or committees to consider: (Some of these suggested topics could be used in social studies.)
   a) *Different kinds of broad-leafed trees.*
      1) Deciduous vs. non-deciduous.
      2) Where they grow, why they lose their leaves, etc.

      Collect branches with and without leaves, make charts and send for charts to illustrate above and other points.
   b) *Different kinds of needle-leafed trees.*
      1) Where they grow.
      2) When they lose their leaves.
      3) Different kinds of cones and needles.

      Collect specimens to illustrate above points.
   c) *Photosynthesis* — Demonstrate necessity of:
      1) Light:
         a. Place a potted geranium plant in a dark room for 24 hours.
         b. Place a similar plant in the full light.
         c. Remove leaves from both plants after 24 hours.
            1. Extract chlorophyll and test leaves for the presence of starch.
            2. N.B. If variegated geraniums are used: Can use the same material to demonstrate necessity of chlorophyll.
      2) Carbon dioxide:
         a. Place geranium plant in CO_2-free air, i.e., under bell jar where all entering air has to pass through potassium hydroxide (or some other CO_2-absorbing compound).
         b. After 24 hours remove a leaf, extract chlorophyll, and test for starch.
         c. Compare with leaves of plant which had access to CO_2.
   d) *Transpiration*—To demonstrate:
      1) Prepare a potted geranium plant so no moisture can escape from pot or soil—glazed pot with layer of paraffin over soil.
      2) Place under closed bell jar. *Note* moisture condensation on inside of jar.
      3) Can also be demonstrated by placing sealed plant on scales for several days—note loss of weight.
   e) *Sequoias*—Oldest living trees.
      1) Obtain samples of wood, branch and cones.
      2) Integrate with history.
   f) *Annual rings in wood (xylem) of trees.*
      1) Collect cross cuts of differ- trees to show rings.
      2) Count the annual rings and integrate with weather, age of tree, etc.
   g) *The Forest Service.*
      1) Make booklet to show duties of forest ranger.
      2) Write and dramatize play to show duties of forest ranger.
      3) Make arrangements with a forest ranger to come to talk to the class.
   h) *Conservation of Forests.*
      1) Group could locate film on conservation and make arrangements to have it shown to class. (See list in part V.)
   i) *Great Forests of the United States.*
      1) Plan bulletin board to show this.
      2) Write to various agencies for maps and charts to use.
   j) *Uses of Wood.*
      1) Group report on such uses as laminated and plywood airplanes and their relation to man's use.
   k) *Food-Producing Trees.*
      1. Collect specimens and arrange on a chart or bulletin board.
   l) *Medicine from Trees.*

1) Quinine—story of its use, etc. Integrate with health education.

m) *Turpentine and Resins from Trees.*
1) Consider uses of these products.
2) Obtain specimens of trees which produce these.

n) *Paper Industry.*
1) Explain how paper is made and show samples of different kinds of paper.
2) This group might make all arrangements for class to visit a paper mill.

o) *Soil Erosion.*
1) Explain what this is and its economic importance. (Tie in with social studies.)
2) Demonstrate by:
a. Use two boxes of soil molded to resemble hills and valleys.
b. Plant grass on one (merely to save time—be sure to explain that tree roots would hold soil and litter would also) and leave other bare.
c. After grass is well established, pour water over both flats (to resemble rain) and notice what happens.

p) *Animals That Live in Trees.*
1) Plan field trip to observe this. This could lead to formation of Audubon Club and/or study of animals.

q) Plant various tree seeds and watch them grow.

N.B. The above topics were chosen to give a range of activities from actual (active) demonstrations (photosynthesis, etc.); straight reporting (medicine); and civic projects (bulletin boards, field trips, etc.).

2. Plan field trips to:
a) Nearby park to study different kinds of trees.
b) Nearby museums.
c) State or federal park, if nearby, to interview forest ranger.
d) Paper mill or pulp mill.
e) Collect specimens.

3. Make collections of:
a) Different kinds of leaves and /or cones.
b) Different kinds of tree seeds and/or fruits.
c) Twigs of different trees to show age of each.
d) Different kinds of woods and identify.
e) Different fruits produced by trees.
f) Different kinds of spices.

4. Prepare charts to illustrate any of above.
5. Keep bulletin board with a different tree illustrated each week.
6. Write letters to Forest Service, United States Department of Agriculture, etc., for information concerning trees, their products, etc.
7. Plant a tree in school yard—espe-if Arbor Day should come during unit.
8. Art lessons could include:
a) Spatter prints of leaves.
b) Leaf prints.
c) Drawings and/or paintings of leaves, trees, or fruits.

V. Source Material

A. *General:*

1. Maps and charts:
a) *Forest Regions of the U. S.* (Map) 18″ × 24″ in color. Free. U. S. Government Printing Office, Washington, D. C. 1948.
b) *How a Tree Grows.* (Poster) 16″ × 21″ in color. Free to teacher. Forest Service, U. S. Dept. of Agriculture, Washington, D. C. 1948.
c) *What We Get from Trees.* (Chart) 28″ × 40″ in color. Free. Forest Service, U. S. Dept. of Agriculture, Washington, D. C. 1946.
d) *Where We Grow Our Trees.* (Map) 27½″ × 34″ in color. Free. American Forest Products Industries, Inc., 1319 18th St., N.W., Washington 6, D. C.

2. *How Chocolate Products Are Made.* Lamont, Corliss & Co., 60 Hudson Street, New York 13, New York. 1950. Free to teachers. Exhibit box showing six steps in manufacture of chocolate from cacao bean to finished product.

3. *Manual of Spices.* American Spice Trade Association, 82 Wall St., New York 5, N. Y. 1947. Free.

B. *For Teacher:*

1. *Pamphlets:*
a) *An Outline for Teaching Conservation in Urban Elementary Schools.* U. S. Dept. of Agriculture, Education Section, Soil

Conservation Service, Washington, D. C. No date. Free.

b) *Curriculum Content in Conservation for Elementary Schools.* Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Bulletin 1939, No. 14. 1940. 15 cents.

c) *Forestry* (Price list 43, 39th edition). Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 1947. Free. (Bibliography of inexpensive materials concerning American Forestry.)

d) *Our Abundant Forests.* National Lumber Manufacturers Association, 1319 18th Street, N.W., Washington, D. C. No date. Free.

e) *Our Forests: What They Are and What They Mean to Us.* U. S. Government Printing Office, Washington 25, D. C. 1944. 10 cents.

f) *Our Nation's Forests.* Emergency Conservation Committee, 734 Lexington Ave., New York, N. Y. 1938. 15 cents.

g) *Some Plain Facts About Forests.* (U. S. Department of Agriculture Forest Services Miscellaneous Publication No. 543.) Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 1949. 10 cents.

2. *Books and Periodicals:*

a) Armstrong, Margaret. *Field Book of Western Wild Flowers.* G. P. Putnam's Sons.

b) *American Forests.* American Forestry Association, 919 17th St., N.W., Washington 6, D. C. $5.00 per year.

c) *Bulletin 233B—Social Living Bulletin.* Pennsylvania State Department of Education, Harrisburg, Pennsylvania.

Page 257—Examples of units.

Pages 262–265—Units on trees at different grade levels (1 through 8).

Pages 472–474—Sources of free materials.

d) Craig, Gerald C. *Science for Elementary School Teacher.* Ginn & Company. 1949. (Pages 350–353.)

e) Fernow, B. E. *Care of Trees in Lawn, Street, and Park.* Henry Holt & Company, New York, N. Y. 1910.

f) *Free and Inexpensive Learning Materials.* Division of Surveys and Field Services, George Peabody College for Teachers, Nashville, Tenn. 1950. 50 cents.

g) Gray, Asa. *Manual of Botany (Flora).* American Book Co., New York, N. Y. 1950.

h) Grimm, W. C. *Trees of Pennsylvania.* Stackpole & Heck, New York, N. Y. 1950.

i) Harrison, J. M. *Elementary General Science.* Book I. Longmans, Green & Co. 1941.

j) Hill, Overholtz, and Popp. *Botany.* Second edition. McGraw-Hill Book Co., Inc., New York, N. Y. 1950.

k) Jepson, W. L. *The Trees of California.* Second edition. University of California Press, Berkeley, California. 1923.

l) Kern, Frank D. *Essentials of Plant Biology.* Harper & Bros. Publishers, New York, N. Y. 1947.

m) McMinn, H. E., and Maino, E. *Illustrated Manual of Pacific Coast Trees.* University of California Press, Berkeley, Calif. 1935.

n) Sudworth, G. B. *Forest Trees of Pacific Slope.* U. S. Government Printing Office, Washington, D. C. 1908.

o) *Science Guide for Elementary Schools.* Vols. I–VI. California State Department of Education, Sacramento, California. 1934–41.

p) *Science News Letter.* Science News Service, Inc., 1719 N St., N.W., Washington 6, D. C. $5.50 per year.

q) *Trees.* Yearbook of Agriculture 1949. Obtain from U. S. Government Printing Office or free from representative or senator.

C. *For Pupils.* (No pages are given because it is believed to be better for the child to learn to use the table of contents and index.)

1. *Pamphlets:*

a) *How Money Grows on Trees.* International Paper Co., Southern Kraft Division, Mobile, Alabama. 1949. Free. (Colored comic dealing with conserving trees.)

b) *Lumber* (by Ethel K. Howard). Chas. E. Merrill Co., Columbus 15, Ohio. No. 607. 1946. 20 cents. (Map of forest belts, types of lumber and lumbering methods.)

c) *Paper—Its Story*. Crown-Zellerbach Corporation, Rincon Annex, Box 3475, San Francisco, Calif. No date. Free. (Story of papermaking, past and present.)

d) *Plants That Give Us Food* (by Mae McCrory). Chas. E. Merrill Co., Columbus 15, Ohio. No. 204. Revised 1947. 20 cents. (Describes how plants make food and what plant parts are used for food.)

e) *Pulpwood, Key to Sustained Forest Income*. Union Bag & Paper Corporation, Savannah, Georgia. 1948. Free. (Illustrated description of forest conservation at elementary level.)

f) *Trees* (by Lillian McKee). Chas. E. Merrill Co., Columbus 15, Ohio. No. 407. 1947. 20 cents. (Trees of different climates, values, enemies, etc.)

g) *Two Trees*. American Tree Association, 1214 16th St., N.W., Washington 6, D. C. 1946. 10 cents. (Conservation of trees at elementary level.)

2. *Booklets:*

a) Parker, Bertha M., *et al.* (Basic Science Education Series). Row, Peterson & Co., White Plains, N. Y. 1942–48.

1) *Birds in the Big Woods*
2) *Birds in Your Backyard.*
3) *Flowers, Fruits, and Seeds.*
4) *Leaves.*
5) *Plants Around the Year.*
6) *Plant and Animal Partnership.*
7) *Plant Factories.*
8) *Saving Our Wild Life.*
9) *Seeds and Seed Travels.*
10) *Trees.*
11) *Useful Plants and Animals.*

3. *Books:*

a) Beauchamp, W. L., Williams, M. M., and Blough, G. O. *Science Problems*. Book 3. Scott, Foresman & Co., New York, N. Y. 1947.

b) *Childcraft*. The Quarrie Corporation, Chicago, Illinois. 1939. Volume 10. *Nature Excursions.*

c) Comstock, Anna. *Handbook of Nature Study*. Comstock Publishing Co. 1939.

d) Limbach, Russell. *American Trees*. Random House, New York, N. Y. 1942.

e) Marx, D. S. *The American Book of Woods*. Botanic Publishing Co., Cincinnati, Ohio. 1940.

f) Marx, D. S. *Learn the Tree from Leaf Prints*. Botanic Publishing Co., Cincinnati, Ohio. 1938.

g) Persing, Ellis C., and Thiel, C. L. *Elementary Science by Grades*. Books 4, 5, and 6. D. Appleton & Co., New York, N. Y. 1930.

h) Rogers, Julia E. *A Tree Book*. Doubleday, Page & Co., New York, N. Y. 1908.

i) Weed, C. M. *Our Trees—How to Know Them*. Lippincott, Philadelphia, Pa. 1936.

4. *Magazines:*

a) *Outdoors Illustrated*. National Audubon Society, 1000 5th Ave., New York, N. Y.

b) *Junior Natural History*. Museum of Natural History, Central Park West at 79th St., New York 24, N. Y.

D. *Moving Pictures:*

1. *Forests & Conservation*. 10 min. Sound & color. Coronet Films, 65 E. South Water St., Chicago 1, Ill. 1946.
2. *Forests Forever*. 16mm. Sound & color. 3 reels. 30 min. U. S. Forest Service, Bankers Security Bldg., Philadelphia 7, Pa. 1945.
3. *Forest Ranger, The*. 16 & 35mm. Sound. 3 reels. 30 min. U. S. Forest Service, Bankers Security Bldg., Philadelphia 7, Pa. 1941.
4. *From Forest to Fireside*. 16mm. Sound. 3 reels. 35 min. Western Pine Assn., Yeon Bldg., Portland 4, Oregon. (Ponderosa pine from felling, through sawmill, seasoning, and conversion of lumber into building materials, etc.)
5. *Gift of Green*. 35mm. Sound & color. 30 min. Sugar Research Foundation.
6. *Green Harvest*. 35mm. Sound & color. Free. Modern Film Corporation, 729 7th Ave., New York 19, N. Y. (Shows relationship between wild life and forestation. How forest fires are spotted and prevented, tree care, planting, etc.)

7. *Green Plant.* 35mm. Silent. Encyclopaedia Britannica Films, Chicago, Ill. (Shows relationship of photosynthesis to other organisms.)
8. *Leaves of Plants.* 35mm. Sound. 12 min. Encyclopaedia Britannica Films.
9. *Romance of Mahogany.* 16mm. Silent. 3 reels. 45 min. Mahogany Association, Inc., 75 East Wacker Drive, Chicago 1, Ill. (Traces mahogany from west coast of Africa, native life, tree felling, sawmill operations, etc. Good for social studies and geography also.)
10. *Seasonal Changes in Trees.* 35mm. Sound & color. 10 min. Coronet Films, 65 E. South Water St., Chicago 1, Ill. 1949. (Introduction to study of trees and their seasonal changes at the elementary level.)
11. *Strength of the Hills.* 35mm. Sound. (U.S.D.A.) Castle Film Co., Russ Bldg., San Francisco 4, California. 1941. (Excellent for conservation.)
12. *Story of the Forest.* 16mm. Sound. 4 reels. 40 min. Venard Organization, Peoria 2, Ill. (Shows part forest plays in water control, soil erosion, and recreation.)
13. *Story of Plywood.* 10 min. Sound. Bailey Films, Inc., 2044 N. Berendo St., Hollywood 27, Calif. (Manufacture and uses of plywood.)
14. *Tree Grows for Christmas.* (U.S.D.A.) Sound & color. 11 min. United World Films, Inc., 1445 Park Ave., New York 29, N. Y. 1949. (Story of Christmas tree, proper forest practice, trimming tree.)
15. *Trees to Tribunes.* 11 min. Sound & color. Free loan from Chicago Tribune. 1943.

VI. Evaluation

A. *Was there sufficient interest to warrant using this unit again with another class?*
   1. Did the children do more work than was required?
   2. Were the children enthusiastic about the project?
   3. Did the unit hold their interest throughout? If not, where and why?

B. *Were the activities well chosen?*
   1. Did they fit in with the life and activities of the community?
   2. Did they use community resources?
   3. Did they help the child learn more about his own locality?

C. *Was there sufficient or too much material collected?*

D. *Children's evaluation.* (The following could be decided upon by class discussion.)
   1. Require each child to write a short theme on:
      a) What he liked best about this unit and why.
      b) What he liked the least about this unit and why.
      c) What new information was learned.
      d) What he didn't learn that he would like to know about trees.
   2. Game activities.
      a) Divide class into teams and have spell down type of game on:
         1) Leaf identification.
         2) Wood identification.
         3) Naming foods from trees.
         4) Guess trees from descriptions given.
         5) "20 Questions" patterned after radio program. Only the moderator knows what specimen is and in 20 questions the student identifies as to animal, vegetable, or mineral.
      b) Dramatizations by groups on:
         1) Effects of soil erosion on farm life.
         2) Duties of forest ranger.
         3) What happens to a family in the path of a forest fire, i.e., what should be done to evacuate, etc.
         4) Other topics to be suggested by the class.

MOST OF THE MARCH 1952 issue will be devoted to a report of a program of the Philadelphia Meeting. The condensed minutes and certain other news items will appear next month. The list of new officers is on page 22 of this issue.

Vocabulary Development to Improve Reading and Achievement in Science

RAY F. DECK
Palmyra High School, Palmyra, Pennsylvania

Through experience as a teacher in science the writer has concluded that the inability to read with comprehension accounts for pupils who are interested in science but not interested in the reading of science. This difficulty is largely one caused by the vocabulary of science. Thus there is need for procedures which serve to help them develop an interest and desire to read with understanding and at the same time grasp the content of the science material.

It is all too easy to assume that students have learned through previous experiences the necessary vocabulary for topics in science. Instead we should realize that each field of science has its own technical vocabulary and that we must develop with pupils the terms necessary to understand the basic concepts which the particular unit of science is designed to develop. The nature of the problem is twofold; first, the teacher must identify the words or terms which may be new or difficult. Second, the teacher must discover and arrange learning activities which help pupils develop meanings and facility in the use of technical words.

This article presents procedures used by the writer. To make the procedures specific they are related to a particular unit in biology entitled, "Our Welfare Is Tied up with That of Other Living Things."

Preliminary Planning

Before introducing the unit to the students the writer made a careful selection of words and terms on which pupil difficulty was anticipated. A list of one hundred thirty-eight words or terms was formed, and each word was studied to see in what way it could best be learned. In selecting the words the writer relied on his experiences with pupils, realizing that more techniques might be used. These words were then segregated into different categories as follows:

1. Those which were considered as key words of the unit, such as pollination, interdependence, nitrification, parasite, and symbiosis.
2. Words that serve as basic stems in the learning of related words; e.g., pollen as the base for pollination, self-pollination, cross-pollination; depend as the base for dependent, independent, interdependence.
3. Terms needed to identify the basic concepts of the unit; e.g., nitrate, nectar, lichen, nodules, terracing, shelter belt, stomach poison, arsenate, public domain.
4. Words which present the possibility of mechanical difficulty; e.g., ichneumon fly, entomology, exploitation, inevitably, exquisite, insectivorous.
5. Words which are new to many pupils but not especially necessary to understand basic concepts; e.g., mongoose, symbionts, seine, lespedeza, plum curculio, cormorants.
6. Words which should be learned by associating them with objects, typical of which are pollen, nectar, legumes, gypsy moth, lichen and termites.
7. Terms which should be learned by experiences or a background of associated activities; e.g., balanced aquarium, balance of nature, biological control, gullying, overgrazing, crop rotation, check dam, green manure.
8. Words to be learned because they are necessary in a world becoming more dependent upon science; e.g., inocula-

tion, nitrification, shelter belt, contour cultivation, sanctuary, contact poison.

9. Technical scientific words—insectivorous, quarantine line, clean-cultivated crops, close-growing crops, migratory, denitrification.
10. Words demanded by exact biological terminology—pollination, parasites, symbiosis, biological control, limiting element, propagation.

Having segregated these words and terms into the various groups it was recognized that some of them fit into more than one group. This is as it should be and naturally means that the same word or term will be presented and used in its varied different groupings, and undoubtedly will be fixed and learned the better thereby.

Development of the Unit

The unit was introduced by relating an interesting account of an interdependence of living things.

The key words pertaining to the first division of the unit were written upon the blackboard and underlined with colored crayon. This list included pollination, interdependence, and other of this type.

Another list of all the new words on which difficulty of comprehension by the pupils was anticipated were listed. This list included pollen, nectar, depend, dependent, independent, and similar words, all of which have a direct relation to interpretation of the key words.

In order to familiarize pupils with these words the following activities were used.

1. Showing actual flowers with their pollen and nectar glands, and making microscopic examinations.
2. Showing pictures of bees and other pollinating insects on flowers.
3. Examining live bees in specimen jars or showing preserved bees and observing means of carrying pollen.
4. Mounting legs of bees and mouth parts on slides and showing on seoscope to pupils.
5. Projecting mounted specimens of lengthwise sections of pistils to observe stages of fertilization of ovules.
6. Asking pupils to read an account of the failure of raising clover seed in New Zealand until the introduction of the bumblebee. This serves to create a stage for the understanding for the word *depend*. Using depend as a stem of a basic word, teach the meaning of *dependent*, *independent*, and *interdependence*.

In order to clarify and enrich the meanings of the above words, questions such as the following were suggested to stimulate purposeful reading.

1. Why do fruit growers wish for fair weather during the time their fruit trees blossom?
2. Why do apiarists desire to have fields of clover or buckwheat growing close by?
3. Why are night-blooming flowers frequently white?

Reading of certain books and magazines was suggested so that pupils might do some research findings as to discovering some specific cases of interdependence of insects and flowers.

The second division of the unit, namely, the nitrogen cycle, and all other subsequent divisions of the unit were taken up in study in the same procedure. The list of key words of each subsequent division was added to original list until eventually the whole list of key words for the unit was completed and in view on the blackboard. However words from the other classifications were only presented and written on the blackboard as they appeared in the respective divisions and as they were being taught.

Words or terms newly learned can only be remembered and of value to the learner if he has opportunities to use them again and again. In order to gain more experiences with the new vocabu-

lary and assist the pupils in remembering them, many of the following suggestions were done.

1. Pupils may collect specimens of insects and flowers illustrative of pollination and exhibit them.
2. Draw diagrammatic charts of the nitrogen cycle.
3. Model soil-conservation programs.
4. Exhibit models of wildlife preservation practices.
5. Perform experiments on water absorption, run-off, and erosion of soil.
6. Collect exhibits on parasitism.
7. Carry on simple experiments on soil-conservation in gardens or nearby fields and lots.
8. The class make field trips for observations on interdependence of living things.
9. Conduct an exhibit of pictures portraying examples of the key words learned.
10. Conduct forums on United States reclamation services.

Some of the above projects were carried out while the various divisions of the unit were studied, others were used as summations of facts learned. A few served as a splendid means of summarizing the whole unit on the interdependence of living things. The above list of suggestions are obviously incomplete; they may readily be augmented.

Outcomes of the Unit

The procedures mentioned above result in varied outcomes. Some of the specific outcomes may be stated as follows:

1. It is a varied way of vocabulary development using objective and sensory experiences. Vocabulary development need not necessarily be a dull, uninteresting procedure of drill. In fact, if proper methods are followed in vocabulary building, interest will be increased rather than destroyed.
2. Reading the textbook and other reference literature becomes interesting, understandable and easier to the pupil because of a familiarity with the meanings of the difficult words.
3. The pupil is reading to learn while he is learning to read.
4. The concepts of science are learned as a unit of coherent and correlated facts as they are built up around the key words.
5. Studying and learning science is not a coverage of so many pages but a compilation of interrelated causes and their results.
6. Such a procedure may be academic but it will seem purposeful to the pupil and incidentally he is acquiring a proper habit of work which is one of learning through vocabulary building.

Difficulties to Overcome

Naturally any conceived plan of instruction is not wholly applicable in any and all cases and therefore difficulties may develop. The number and kinds of difficulties arising would depend on local conditions in the school.

1. Forty-five- or fifty-minute periods of class time is too short for some of the experimental and project work.
2. Where other classes meet in the same room as biology, inadequate blackboard space may be reserved for the biology classes.
3. If there is more than one section of biology, using different textbooks, the plan becomes inconvenient and cumbersome to administer.
4. If there is extreme variation of reading ability amongst the members of the class the plan is not equally effective to all students.

Inasmuch as this plan was used in the development of a unit in biology it does not mean that the procedure is thus limited. I feel certain that it can be equally well adapted in any other field of the content studies.

Five past presidents of NABT were present at the luncheon at the Philadelphia meeting when retiring president Weaver presented the president's pin to Harvey Stork, who is the fourteenth president of the association. They were Malcolm Campbell (second), George Jeffers (third), Prevo Whitaker (eighth), E. L. Palmer (ninth) and Ruth Dodge (eleventh).

Tricks of the Trade

IVA WARD MANLEY
Maryville High School, Maryville, Missouri

Oceans of Fun with OCHNS

My favorite demonstration is stored in a box on a shelf from year to year. It consists of three wide-mouthed bottles tightly stoppered and labeled oxygen, hydrogen and nitrogen respectively, a large stick of charcoal, and a lump of roll sulfur.

When discussing the composition of protoplasm we display these elements, and usually ask,

"Now if we empty all these elements into this large jar and stir them thoroughly, what will we have?"

Some pupil usually answers, "Protoplasm." The amusement which follows this answer launches us into a discussion of elements, compounds, mixtures, chemical changes and living matter.

Later in the year, during the study of foods, the same materials are brought out with the addition of an iron nail and strips of copper, zinc and magnesium. Three small bottles also exhibit small pieces of phosphorus, sodium, and potassium, each element covered with the appropriate liquid in which it is kept, and labeled with safety instructions. Another small bottle contains a lump of calcium.

We set out a large plate, and say,

"Suppose your mother knows the elements you must obtain from your food and she wants you to be well nourished. Suppose she should put on this plate the bottles containing hydrogen, oxygen, and nitrogen and this lump of sulfur and this stick of carbon. Then knowing you need minerals also, she puts on these lumps of phosphorous, sodium, potassium and calcium, and this iron nail, and these pieces of copper, zinc and magnesium. Would it make you a satisfactory meal?"

This furnishes a starting point for the discussion of foods, chemical changes during food manufacture by plants, and digestion and assimilation of foods by animals.

At the end of the discussion some pupil always asks, "Do you really have oxygen, nitrogen and hydrogen in those bottles, or is it just air?"

He is invited to make the tests to identify these gases, and, as he suspected, it seems to be just air. The class always agrees that there would be no advantage in having the actual gases in the bottles, but that it would be a good idea to say nothing about this to the other division. "Let them find it out for themselves."

BIOLOGY LABORATORIES

By "The Old Fossil"
At Lane Tech, Chicago

Goldfish food used last winter was purchased at a pet store. This food was ordinary dog food, compounded as a balanced ration in granular form, with a shagreen surface. Some of the pellets were the size of a pea but most of them were smaller. The food is handy, cheap, and easy to feed. We have several hundred goldfish in the greenhouse in three large horse watering tanks. These are aerated. We rarely lose over two or three fish per week; which is a low per cent. Since five pounds of rolled oats came through the science supplies I have used most of this with the granulated food.

Guppies enjoy a piece of beef tied on the end of a string and suspended in the water. The junior member of the firm feeds her brood about twice a week in this manner.

The unused food is removed at the end of an hour to prevent spoilage, and water contamination.

HER RED RAMSHORN SNAILS prefer lettuce, curled parsley, cabbage, and onion tops in that order. The green food should be fresh and renewed twice a week.

WOOD ROT AND TERMITE ATTACK may be retarded with chemicals. We have purchased five gallons to be used during the next few months for preservation of greenhouse benches, seed flats, and soil storage bins as they become empty. One gallon (painted on) covers 300 square feet of surface. On the farm we use crankcase oil to preserve the wooden covering of the wells. Two or three applications on the dry wood gives us several years more durability. I see no reason why the same could not be used around a greenhouse.

HUMAN BIOLOGY for high schools is the interest of Maurice Finkel of Colorado. He feels that this phase of biology is neglected in the smaller schools operating under a limited curriculum. He desires the comments of TOF. TOF believes that every student should receive more information and in greater detail than most students receive today. Human biology is not too far afield. The Old Fossil has followed this swing of the pendulum in his teaching. Thirty years ago he was teaching physiology (the only biology subject taught in that high school) in New Mexico. Three years later he was teaching Health Education in Indiana (the only biology subject taught in that high school). Two years later he was teaching Zoology, General Science and Botany in the southern part of Illinois. His present Certificate to teach biology in the Chicago Public Schols is a little more than half a score of years old and it was the first of its kind issued. Concluding; the human biology course is no more nor no less than the course outlined by the individual teacher. If the teaching biologist uses a human biology theme and instructional aids and materials supporting this premise, he will be headed in the right direction.

PLANT SHADING is accomplished by using camouflage cloth which was developed by the Army in World War II. This cloth is suspended and stretched from the ceiling and side walls of the greenhouse. This gives partial shade of about thirty per cent. The cloth has different percentages of shading. It comes in 84 and 108 inch widths. For twenty-some dollars we purchased 50 yards of the narrower width. Be sure to get the nontoxic cloth as the "Victory Cloth" is treated chemically to prevent rot and is toxic to plants. Any surplus may be used for fish seines, or insect nets made by the pupils.

KROFT LILIES were purchased last fall in the bulb stage. Six dozen were potted in five inch pots (bulb type) with a mixture of five parts loam and one of peatmoss. These were left in the clocktower storage room, which is next to the greenhouse, for a period of several weeks. There is no heat in this room and the temperature generally is slightly warmer than the outside. In early November they were brought into the greenhouse and run at room temperature. The Big Freeze (February) caught half dozen growing tips which were above the soil. We wanted them to come in by Easter for a display but we were unsuccessful.

HYACINTH BULBS purchased in the fall were a complete fizzle. The growing tip would develop a rot and the flower would blast. A letter, in a circuitous route, from the importer informed us that this was a common occurrence, possibly due to too close trimming. We tried dusting them with the common fungicides, but no successful results were evident. Imported bulbs, especially prewar Japanese bulbs, were trimmed very closely to decrease shipping space.

AMARYLLIS BULBS started in the fall were also nipped in The Big Freeze. About four of the three dozen were sticking their growing tips out of the bulb at the time. These were a complete flower loss but they will bloom this year. Be sure and buy top size bulbs and get some of the new hybrids for flower color. The spent plants are left in the pots, fed occasionally and plunged in the garden during the summer until fall. They are then thrown under the bench for a period to rest. Later they are repotted and ready for winter flowering again.

THE BOARD OF EDUCATION furnishes all textbooks. In place of supplying a copy of the text to each student, sets of the book (sufficient for a class) are kept in each classroom. The individual classrooms may have as many as ten different text sets for that room. The students have access to these several different texts in their classroom; however, copies do not circulate out of the room. In the library ten copies of each text are kept on the shelves, in addition to these sets. Students desiring to make up back work or to do extra credit work can go to the library for these books. Copies may be withdrawn the same as other books in the school library. This is a Lane innovation; not an administrative or board rule.

ONE OF MY STUDENTS vacationed for a time in Florida, a few years ago. This week he brought in two pecks of specimens that his mother could no longer house in their small apartment. The collection consists of many whelks an inch long to some which were twenty inches in circumference; starfish; and sundry bivalve shells. This is an excellent example of an activity which could initiate creative work in the future.

GREEN THUMB INHIBITOR. Mother, living in Indiana, comes up with this deduction. She has found that plants watered with "softened" water will not thrive. The chemical treatment given their household supply of water adds something harmful to the plants. She now waters her plants with water which bypasses the softener.

HAROLD M. AUGUST of Pennsylvania writes: "Congratulations from a new member . . . . Your column is very helpful and your comments are both humorous and human." Seriously, thanks, HMA. To you other guys and gals, if you are still disturbed with something in your mental craw, get out your writing iron and fire away at "The Old Fossil," 5061 North Saint Louis Avenue, Chicago 25.

REVIEWS

SACKS, JACOB. *The Atom At Work*. The Ronald Press Company, New York. xii + 327 pp. illus. 1951. $4.00.

Dr. Sacks offers two reasons for the writing of this book. They are: "To remove the mystery surrounding atomic energy from the minds of all of us who are interested; and to show the constructive and hopeful side of the story of atomic energy." Had the author limited his work to either objective, the book would still be a desirable accomplishment.

Historically, there is included an informative résumé of the Curies' discovery of radioactivity and the many events, people, and machines which contributed to atomic fission and the production of radioactivity. In addition, the book tells the current story of how isotopes and artificial radioactivity are used in the fields of chemistry, biology, industry, and medicine in an effort to better understand, among other things, disease, fertilizers, penicillin, photosynthesis, the elimination of static, the location of defects in metals, and to make better rayon and tires.

The high standard physical features, clear illustrations, excellent literary style, and nontechnical language combine to make this book one of the best in this field.

LEE R. YOTHERS,
High School,
Rahway, New Jersey

LWOFF, ANDRE. *Problems of Morphogenesis in Ciliates*. John Wiley & Sons, Inc., New York. ix + 103 pp. illus. 1950. $2.50.

This is a monograph of a highly specialized nature. In it the author considers certain self-reproducing granules of ciliates, the kinetosomes, in their relations to such processes as differentiation, development, morphogenesis, evolution and reproduction. The author presents evidences: that kinetosomes have a morphogenic force; that they are frequently segregated in some cells and not in others; that this irregular distribution

changes the potentialities of the cells; that the fate of kinetosomes depends on their metabolism, their positions in the organism, and on several factors of the environment. He discusses some of the problems which arise from these facts, and suggests possible uses of these facts to explain cell differentiation and protoplasmic inheritance. The terminology is somewhat difficult.

Brother H. Charles, F.S.C.,
St. Mary's College,
Winona, Minn.

Crafts, A. S., H. B. Currier, and C. R. Stocking. *Water in the Physiology of Plants.* Chronica Botanica Co., Waltham, Mass., and Stechert-Hafner, Inc., New York. xx + 240 pp. illus. 1949. $6.00.

Water in the Physiology of Plants is a monograph on the relations of water to plant cells. The authors have combined the results of their extensive researches with relevant facts wisely selected from the numerous papers on the absorption, movement and utilization water by plants. As a result the book is a synthesis of present day concepts relative to water utilization by plants. It offers students an attractive means of becoming better acquainted with contemporary literature dealing with the mechanism of osmosis, the uptake, movement, retention and loss of water. Those who, because of lack of time, are unable to give the entire book a thorough reading can bring themselves up-to-date on plant-water relations by reading the excellent summaries which end each chapter. An extensive bibliography of nearly 800 titles is included.

Brother H. Charles, F.S.C.,
St. Mary's College,
Winona, Minn.

Bullough, W. S. *Practical Invertebrate Anatomy.* Macmillan & Co., London. xi + 463 pp. 1950. $4.50.

The beginning of each chapter on invertebrate phyla, from Protozoa up to and including Chordata, describes the general characteristics of the phylum, class, and order of the invertebrates commonly used for study in college zoology. For each representative listed under the genus name, the general account, anatomy, conclusions and references are presented. The general account is a description of the life history of the individual. Under anatomy, the general structure is described, with important words in bold-face type to facilitate the laboratory work on the study of the specimens. As conclusions the author suggests particular characteristics to be noticed and the characteristics of the phylum, class, and order to be compared with that of the specimen being studied. Many of the references listed are of little value to the average small college student as some are written in foreign languages and others cannot be obtained in an average small college library.

In the reviewer's opinion, the section on the anatomy of the specimens might well be separated into a laboratory manual as the text is cumbersome to handle during the lab work. The rest of the information given in the book is excellent reference material. The paper of the text seems poor, however, and might not stand hard wear in the laboratory. The text is easily read and a person can quickly find the description of the specimens he wishes to look up. The table of contents is comprehensive; listing the phylum, class, order, genus, and the common names of all the representatives given in the book. There are 168 excellent figures and the text is concluded with general references, general appendix, index of authors and general index.

Lois Redmond,
State Teachers College,
Emporia, Kansas

FILMSTRIPS

Three new agricultural filmstrip series in full natural color, *Selection of Breeding Stock—Beef; Selection of Breeding Stock—Sheep;* and *Selection of Breeding Stock—Hogs,* have just been released by the Audio-Visual Division, Popular Science Publishing Company, 353 Fourth Avenue, New York 10, N. Y. Each of the three series consists of two full-length filmstrips, one devoted to the male and the other to the female of the species, with emphasis on points that teach students to recognize and evaluate best breeding characteristics of the animals. Each series comes with a helpful Teaching Guide that provides ample background, development and review material to teachers and group leaders.

Biological Monographs

Methuen & Company, Ltd., London, has published a series of biological monographs which are designed to "give brief but authoritative accounts of the present state of knowledge in various departments of Biology, and to convey information which can be obtained only at the cost of considerable time and trouble by a person who is not engaged in that particular branch." Each pocket-size monograph his been written by an eminent British biologist.

Without exception, the authors of these volumes have presented their complex subjects in a capable, timely, and scientific manner and have succeeded in attaining their goals with considerable success, though one may reasonably regret the inadequate number of illustrations. Each book, reviewed below, contains a selected list of references and an index. The books may be purchased through John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, New York.

White, M. J. D. *The Chromosomes.* (4th ed.) 1950. illus. pp. ix + 124. $1.50.

This book contains an account of the present day knowledge of the structure and function of chromosomes and the principles which govern the evolutionary transformations of chromosomes. In Chapter I of the book is found an excellent discussion of the physical and chemical status of the nucleus during its so called resting state. Chapters II and III offer a general outline of the phases of mitotic division, and special problems as number, form, size of chromosomes, and genetically active and inert chromosomes. This is followed by two chapters describing meiosis. Finally, the author discusses chromosomes and evolution, presenting the scientific facts which support this concept and the aspects of heredity which have brought about evolution.

Baker, John R. *Cytological Technique.* (3rd ed.) 1950. pp. vii + 211. illus. $1.75.

This monograph has been prepared primarily as a manual for a basic laboratory course in cytological techniques. In addition, it bears briefly on the related fields of histology and pathology. The book's content and exposition are among the best this reviewer has read in this field of biology. Beginning with a discussion of cells, which is outstanding, the author lays a foundation for understanding the step-by-step laboratory techniques for working with cells. The remainder of the book presents problems and clear cut directions describing the techniques and materials for performing the operations of cell fixation, simple fixation, fixing mixtures, microtomy, staining, mounting methods for chromosomes, mitochondria, and the Golgi element.

Wigglesworth, V. B. *Insect Physiology.* (4th ed.) 1950. pp. x + 134. illus. $1.25.

To advance the control of insects, applied entomologists have intensified their study of the structure and function of the organs and tissues of these animals. The content of this volume, based on a digest of nearly 2,000 publications and on original work by the author, presents a composite of pertinent data on insect structure, nutrition, response to sensory stimulation, reaction to parasites, body adaptations to diverse climatic conditions, and the action upon them of toxic sprays and gases.

Mather, K. *The Measurement of Linkage in Heredity.* (2nd ed.) 1951. pp. ix + 149. $1.75.

Since the turn of the century and the rediscovery of Mendel's work, statistic techniques and methods employed in experimental genetics have developed at a rapid rate. To keep abreast of the plethora of genetic research literature which appears annually would involve more time than is usually available to genetical workers. While this book is too difficult to be used as a text in any but the most advanced courses, it will serve to bring to the trained geneticist the latest statistical findings and methods, and to provide the necessary instructions and encouragement for their use. The chapter headings indicate the content of the book. They are: Two Class Segregations, The Planning of Experiments, Detection of Linkage, Estimation of Linkage, Combined Estimation and Testing Heterogeneity, Disturbed Segregations, Human Genetics, The Estimation of Gene Frequencies, and Symbols and Formulae.

Lee R. Yothers,
Rahway High School,
Rahway, New Jersey

A change in format of The American Biology Teacher was authorized by the Representative Assembly at the Philadelphia meeting. The cover page will feature a photograph of biology teaching interest. More details will be forthcoming in an early issue.

NATIONAL INSTITUTE FOR SCIENCE TEACHERS

Your editor attended the second *National Institute for Science Teachers*, held at Glenmont, Llewellyn Park, West Orange, New Jersey, November 12 and 13, 1950, by the Thomas Alva Edison Foundation. General meetings and group conferences were held during the first day and the morning of the second day on the problems involved in the current shortage of engineering and scientific personnel. The afternoon of the second day was devoted to a general session of the entire group, during which the summarized ideas were thrown into the hopper by the various participating groups. The report was then formulated by a committee appointed for that purpose.

The somewhat abridged report follows; we regret that it is not possible to publish the report in its entirety in one issue, but to do so would have postponed it until the April issue.

We are living in a competitively technological age, and the success of a nation in such a field rests largely on the originality of thousands of engineers and scientists employed in its industries. An expanding economy and a consequent rising standard of living depends on new products and markets created by the technical resources of industry.

Studies of England give clear evidence to the fact that a chief cause for its industrial decline and loss of world leadership was England's failure to train and utilize adequate numbers of engineers and applied scientists so necessary to competitive strength and growth in our modern technological civilization. The United States may be heading in the same direction according to statistics presented at the Institute.

The survival, growth, and future strength of Western civilization can be anchored to the problem of increasing the quantity and quality of the engineering and scientific manpower of the United States.

Specific steps for immediate action recommended by those attending the Institute were that:

Participants should:

Write articles on the opportunities for young people in engineering and science for their respective professional journals, constantly reminding and urging them to keep alive the continuing and expanding problem of the quantity and quality of engineering and scientific personnel for the responsible positions in government, industry, and education in this country.

Arrange for discussions of the shortage of engineers and scientists at national and regional conventions of English, social studies, mathematics and science teachers, superintendents, and national professional societies concerned with engineering, science and education.

Encourage industrial managers to make the shortage of engineers and scientists the subject of their public addresses.

Arrange for publication of articles on the shortage in business and industrial employee publications.

Communicate the proceedings of the Institute to as many people as possible through personal contact with students, parents and colleagues.

Arrange special conferences on the subject of the shortage of engineers and scientists for representatives of industry, government and education. The first direct result of the Edison Foundation Institute was the conference on "The Shortage of Technical Manpower," called by the U. S. Office of Education.

Initiate the discussion of the problem among local groups of people corresponding to the roster of participants attending the November 12 and 13 Edison Foundation Institute.

Elementary and secondary schools should:

Work through State Departments of Education in increasing the availability of correspondence courses in mathematics and science for able students in high schools where there are too few to warrant offering the courses on a classroom basis.

Undertake critical studies cooperatively, through State Departments of Education, to discover the specific factors that cause high enrollment and continued interest in mathematics and science in some schools and the opposite in certain other schools.

Examine history courses and be sure

there is adequate emphasis on the economic and social impact and significance of accomplishments of science and engineering. Teachers Colleges, State Departments of Education, and Boards of Education, along with individual teachers, must meet this challenge.

Expand teacher and student visits to local industries so that there may be vivid personal observations of what engineering and scientific jobs require and accomplish.

Provide enthusiastic leadership and interest among the teaching staffs for initiating and maintaining science, engineering, mathematics, and other related forms of clubs and activities which include science clubs, science talent searches, science fairs, science congresses and assemblies.

Recognize the differences in interests, abilities, modes and rates of learning that characterize youth. Superintendents, principals and teachers should constantly hammer away at the public to educate them regarding sound policies concerning teacher-student ratios.

Encourage superintendents, principals, and science teachers to actively and energetically seek mutual working relationships with industrial and business organizations of each community which might serve the school in relation to engineering and science training.

Conduct constant, thorough and exhaustive studies on the causes for dropouts in high schools. More than 50% of those entering high school drop out before graduation.

Improve science courses and science training of teachers at the elementary level in order to develop scientific interests of children when they have the greatest urge to learn.

Stress the importance of manual skills.

(Continued in the February Issue)

NEW OFFICERS

The results of the election of officers of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS for 1952 have been received from the Secretary-treasurer. The elected officers, who have assumed their duties as of January 1, 1952, are as follows:

President: Harvey E. Stork, Carleton College, Northfield, Minnesota.

President-elect: Leo F. Hadsall, Fresno State College, Fresno, California.

First Vice-president: Robert C. McCafferty, Central High School, Wadsworth, Ohio.

Second Vice-president: Arthur J. Baker, Crystal Lake Community High School, Crystal Lake, Illinois.

Secretary-Treasurer: John P. Harrold, Senior High School, Midland, Michigan.

National Membership Chairman:

The new president received his B.S. from Indiana State Normal College, his M.A. from Indiana University and his Ph.D. from Cornell University. He taught in elementary and secondary schools in Indiana and was an instructor at Cornell for three years. He is at present a Professor of Botany at Carleton College, Northfield, Minnesota. He has been a director of field expeditions, a director of explorers' camps for boys, and a ranger-naturalist in various western national parks. He has taken part in three expeditions to Central America.

Dr. Stork has been an active member of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS for several years, during which he has taken an active part in a great variety of its activities. He has been a regular contributor to the columns of *The American Biology Teacher*, as well as other educational and scientific journals.

Biographical sketches of the other officers appeared on page 138 of the October, 1951, issue. All of them have been active members of NABT, having served on many different committees and taken part in many activities. All of them are leaders in biology teaching and science education in their respective areas. All of them have shown the breadth of interest that enables them to see the long range problems of science education as well as the day-to-day problems of the classroom. The editorial staff of ABT extends the new officers sincere congratulations and wishes them a happy and constructive year.